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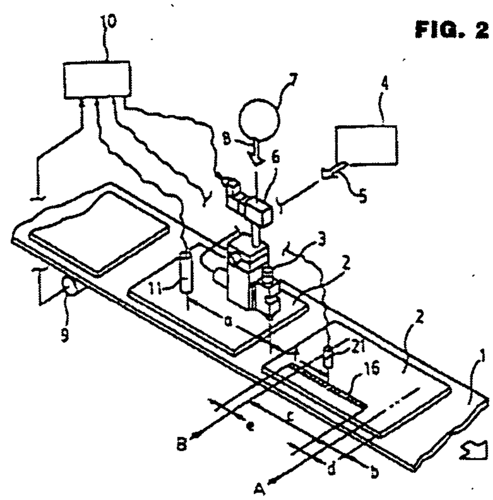
(54) Method for detecting the displacement of a coating pattern and method for correcting said displacement

(57) The object of the present invention is to provide a method for detecting the coating delay inherent in the operation of a spray gun and/or the deviation of the actual coating pattern from a supposedly ideal coating pattern, and moreover a method for automatically correcting the coating pattern deviation, when applying a coating material (16) such as an adhesive or a coating agent by spraying it from a spray gun (3) onto a workpiece (2) being moved by a conveyer (1) or the like.

The method for detecting the displacement of a coating pattern and for the correction of said displacement when spray coating moving workpieces with a coating material from a spray gun is characterized in that the deviation value of the actual coating time from the set coating time value is determined by comparing the set coating time values (T1 and T2) to open and close the spray gun, which have been input in advance in the controller (10) of the coating system, with the actual coating time information (ts and t2) obtained from the sensor (21) used to monitor the state of said spray coating procedure.

FIG. 2



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Description

[0001]

[Technical Field of the Invention]

The present invention pertains to a method for detecting the displacement of a coating pattern and a method for correcting said displacement, in which the coating delay inherent in the spray gun or the deviation of an actual coating pattern from a supposedly ideal coating pattern are detected when applying a coating material such as an adhesive or a coating agent by spraying it from a spray gun onto workpieces being moved by a conveyer or the like, then the deviation is corrected automatically.

[0002]

[Conventional Techniques]

A conventional method for spray coating moving workpieces with a coating material such as an adhesive or a coating agent from a spray gun will be explained with reference to Figures 4 and 5. In this case, the application of an adhesive as the coating material will be described for the sake of convenience. In the figures, *1* represents a conveyer device, said conveyer device *1* advancing in the direction of the arrow by the application of a driving source which is not illustrated. *2* is a workpiece being moved by the foregoing conveyer device *1*, and said workpieces *2* are continuously supplied at given intervals. *3* is a spray gun for spraying an adhesive *5* which is pressure fed from an adhesive feed device *4*, toward the workpiece *2*. Said spray gun *3* will be described in detail later, but an air-driven spray gun is used as an actual example.

[0003]

6 is an electromagnetic valve [*solenoid valve? -- Tr. Ed.*], said electromagnetic valve *6* turning on and off the supply of air *8* from an air supply *7* for driving the spray gun *3*, and thus controlling the operation of the spray gun *3*. *9* is a speed sensor for detecting the speed of the conveyer *1*, then the signal detected by said speed sensor *9* is input and processed in a control device *10* and monitored by a speed meter incorporated in the control device *10*.

[0004]

11 is a work sensor that detects the presence of the workpiece *2*. Said work sensor *11* senses the leading end of the moving workpiece *2*, transmits a signal, then stops transmitting the signal at the point when the workpiece *2* is detected. Furthermore, the work sensor *11* is installed at a position up-stream by a set distance "*a*" from the location of the center of the nozzle of the spray gun *3*, because of structural limitations at the installation site [*presumably the limitation is the installation space that is available -- Tr. Ed.*]. That is, the distance "*a*" is the distance between the work sensor *11* and the spray gun *3*.

The structure and action of the aforementioned spray gun *3* are as follows (with reference to Figure 4): If the electromagnetic valve *6* is turned on and air *8* is supplied from the air supply *7* to the spray gun *3*, the piston *12* of the spray gun *3* is pushed up against the force of a spring *13*, a needle *14* which is directly connected to the piston *12* is also pushed up, the needle valve mechanism is opened, and the adhesive *5* gushes out of the nozzle of the spray gun *3* onto the workpiece *2*, and is thus applied to the workpiece *2*. *16* indicates the adhesive applied to the workpiece *2*.

[0006]

If the electromagnetic valve *6* is turned off and the air pressure which has kept the piston *12* up is released, the piston *12* is pushed down by the restoring force of the spring *13*, the needle valve mechanism is closed, and spraying of the adhesive *5* ends. The restoring force of the spring *13* can be adjusted by the distance that screw *15* is screwed in or out.

[0007]

An air-driven spray gun is described in this example, however, not only air-driven spray guns but also electromagnetic direct-acting spray guns can be used. It is also true, however, that electromagnetic direct-acting spray guns are disadvantageous from the standpoint of the space they take up, since a large electromagnetic coil is needed to provide a given driving force when handling a fluid of high viscosity and at high pressure such as an adhesive. In contrast to this, air-driven spray guns can be designed to be small and compact, which is advantageous when handling fluids of high viscosity and at high pressure.

[0008]

When applying an adhesive by a coating device constructed in this way, the speed *v* of the conveyer *1* is first set with reference to the preceding process and subsequent process, which are not illustrated. This speed *v* is input to the control device *10* artificially or as a relevant indication signal from the preceding or subsequent process device. The non-illustrated driving device for the conveyer *1* is then adjusted to operate at speed *v* based on the speed *v* indication signal from the control device *10*. The speed *v* of the conveyer *1* is monitored by the speed meter in the control device *10* as a signal from the speed sensor *9*.

[0009]

Next, the adhesive coating location of the workpiece *2* is determined. Specifically, a coating start position *A* that is a certain distance *b* away from the leading end of the workpiece *2*, and a distance "*c*" over which the adhesive is to be applied to the workpiece *2* are determined. These location values are then input by calculating the time it takes for the coating start position *A* to advance to a location directly under the spray gun *3* after the leading end of the workpiece has been detected by the work sensor *11*, i.e., time *T1* during which the coating start position *A* advances by the distance "*a*" from the nozzle center position of the spray gun *3* to the work sensor *11*, and time *T2* (corresponding to distance "*c*") during which the spray gun *3* is kept open and the adhesive is applied, i.e., the values *T1* and *T2* are input artificially into the control device *10*.

[0010]

Specifically, the time *T1* during which the coating start position *A* advances to the nozzle center position of the spray gun after the leading end of the workpiece is detected by the work sensor 11, is the distance "$a + b$" divided by the speed *v* being monitored by the speed sensor *9*, and calculated as $T1 = (a + b)/v$. The time *T2* during which the spray gun *3* is kept open, is the distance "*c*" over which the adhesive is applied divided by the speed *v* being monitored by the speed sensor *9*, i.e., it can be calculated as $T2 = c/v$.

[0011]

Once these values, i.e., the speed *v*, time *T1*, and time *T2*, have been set in the control device *10*, the coating work begins. If the leading end of the workpiece *2* is detected (i.e., a trigger signal is generated) by the work sensor *11*, the control device *10* transmits an "open" signal to the electromagnetic valve *6* after time lapse *T1* after the leading end of the workpiece *2* has been detected, which opens the electromagnetic valve *6*. The air *8* for driving the spray gun *3* is then supplied to the spray gun *3*; the piston *12* of the spray gun *3* is pushed up against the force of the spring *13*; the needle *14* directly connected to the piston *12* is also pushed up and the needle valve mechanism is opened; and the adhesive *5* gushes out of the nozzle of the spray gun *3* onto the workpiece *2* and is thus applied to the workpiece *2*.

[0012]

When time *T2* elapses from the start of coating, the control device *10* ceases actuation of the electromagnetic valve *6* and thus turns off the electromagnetic valve *6*, so that the air pressure which has kept the piston *12* up, is released, the piston *12* is pushed down by the restoring force of the spring *13*, the needle valve mechanism is closed, and coating with the adhesive is terminated.

[0013]

In this way, one work cycle of applying the adhesive is completed. Then, when the work sensor *11* detects the leading end of the next workpiece *3* [*sic; 2? -- Tr. Ed.*] (i.e., a trigger signal is generated), another work cycle of the aforesaid coating is begun, and said work cycles are repeated until the work is interrupted.

[0014]

[Problems to be Solved by the Invention]

However, various problems are associated with the coating method mentioned above. For example, and even though the coating process must be started at a position which is distance *b* away from the leading end of the workpiece *2*, i.e., coating start position *A*, and even though the coating must be applied over distance "*c*", the actual coating process starts the coating pattern where the start of coating is delayed by distance "*d*" with respect to the intended coating start position *A*, and ends the coating pattern with the end of coating being delayed by distance "*e*" with respect to the intended coating end position *B*, as shown in Figure 4.

[0015]

Displacements of the coating pattern of this kind are inherent to the use of the spray gun. They are caused by factors such as the time it takes for the piston *12* to be pushed up against the force of the spring *13* after the driving air is supplied. In the case of an air-driven spray gun, the sliding resistance of the piston *12* and the needle *14*, the distance "*h*" from the nozzle tip to the workpiece, and the pressure of the coating fluid, tend to vary in a delicate and indirect manner due to the passage of time and/or friction. Accordingly, even a spray gun produced under the best quality control conditions cannot avoid this delay in the coating time, even though there are some differences from one individual product to another. A coating delay of this kind also occurs even if an electromagnetic direct-acting spray gun is used, although there are some differences in the delay value.

[0016]

This shifting of the coating pattern causes the same delay times when seen in terms of time, but does not vary with respect to a change in [*the conveying*] speed. However, when seen in terms of the magnitude of the delay, i.e., in terms of the coating pattern, the displacement of the coating pattern appears to be proportion-

ately larger with respect to the speed as the production speed increases. Furthermore, apart from the operational delay of the actual spray gun, there can even be a displacement of the coating pattern due to factors such as system failure. Recently, even higher speeds are being sought after from the standpoint of productivity, and pattern displacements of the kind discussed above are the notable causes of lower quality in products that require coating quality of high precision. Clearly, then, improvements are sorely needed.

[0017]

In order to remedy these problems caused by coating pattern displacements, the following method has already been used: a trial coating run is carried out and the results are examined visually by the worker. The distance of the delay from the ideal coating position to the actual coating position is measured and used to calculate the delay time, then time *T1* and time *T2* that have been set in the control device *10* are corrected manually by the worker. Operations like this take a lot of time and labor, e.g., a tremendous amount of time used to be required when starting production of a new product, changing the coating pattern, or repairing or exchanging the spray gun. Furthermore, visual examination can be difficult depending on the type of workpiece and/or the type of coating material, which make it difficult to make highly accurate corrections.

[0018]

The present invention was developed in response to these problems, thus the goal of the present invention is to provide a method for detecting the coating delay inherent in the use of a spray gun and/or the displacement of an actual coating pattern from a supposedly ideal coating pattern, and also to provide a method for automatically correcting said displacement, when applying a coating material such as an adhesive or a coating agent by spraying it from a spray gun onto workpieces being moved by a conveyer or the like.

[0019]

[An Approach to Solving the Problems]

To solve the aforementioned problems, the following methods have been developed and make up the present invention. In a method for spray coating moving workpieces with a coating material from a spray gun, the present invention pertains to a method for detecting the displacement of the coating pattern, characterized in that the deviation value of the actual coating time from a set coating time value is determined by comparing the set coating time values to open and close the spray gun, which have been set in advance in a device for controlling the coating device, with the actual coating time information obtained from a sensor used to monitor the state of the spray coating procedure.

[0020]

Also, in a method for spray coating moving workpieces with a coating material from a spray gun, the present invention pertains to a method for correcting the displacement of the coating pattern, characterized in that the deviation value of the actual coating time from the set coating time value is determined by comparing the set coating time values to open and close the spray gun, which have been set in advance in a device for controlling the coating device, with the actual coating time information obtained from a sensor for monitoring the state of the spray coating procedure; and in that said controlling device is configured so as to output a spray signal to the spray gun by altering the set coating time value by the determined deviation.

[0021]

[Mode of Carrying Out the Invention]

The mode of carrying out the present invention will now be described. The present invention pertains to a method for detecting the displacement of a coating pattern and a method for correcting said displacement as part of a method for spray coating moving workpieces with a coating material from a spray gun by the procedure mentioned earlier, and hence can provide a spray coating method of extremely high quality with no coating delay. Specifically, the set coating time value at a line speed *v* that has been set in a control device for a coating line, based on the design value for a coating pattern, i.e., time (*T1*) until the spray start signal is output to the spray gun after the workpiece is detected by the work sensor, and time (*T2*) during which the spray gun is carrying out the spray coating process, are compared with the actual coating time information (*ts* and *t2*) obtained from a sensor used to monitor the state of the coating spray process in accordance with the above-mentioned times, then the respective deviations are determined, whereby the displacement of the coating pattern can be detected. Moreover, the positional deviation value of the coating pattern is fed back to the set coating time value, then the set coating time value is shifted and modified by said deviation value, whereby the ideal coating pattern can always be obtained automatically.

[0022]

[Actual Example]

The invention method for detecting the displacement of a coating pattern and the method for correcting said displacement in a method for spray coating moving workpieces with a coating material from a spray gun will

now be described in concrete terms with reference to the figures which show an actual example of these methods. Figure 1 is an explanatory diagram which illustrates the principal components needed to carry out the present invention. Figure 2 is an explanatory perspective diagram which illustrates the principal components of the present invention, similar to those of Figure 1. Figure 3 is a diagram which illustrates the various operations involved in the coating work of the present invention as time charts. Parts which have the same function as in the conventional technique are given the same symbols, and will be described as simply as possible.

[0023]

Furthermore, the case of applying an adhesive as the coating material will be described here for the sake of convenience, as in the explanation of the conventional technique described previously. In Figures 1 and 2, symbol *1* represents a conveyer device, and said conveyer device *1* is made to advance in the direction of the arrow by a driving source, which is not illustrated. *2* is a workpiece being moved by the foregoing conveyer device *1*, and said workpieces *2* are continuously supplied at given intervals. *3* is a spray gun for spraying an adhesive *5* which is pressure fed from an adhesive feed device *4*, toward the workpiece *2*. Said spray gun *3* will be described in detail later, but an air-driven spray gun is used as one actual example.

[0024]

6 is an electromagnetic valve, and said electromagnetic valve *6* turns on and off the supply of air *8* from an air supply *7* for driving the spray gun *3*, and thus controls the operation of the spray gun *3*. *9* is a speed sensor for detecting the speed of the conveyer *1*, then the signal detected by said speed sensor *9* is input and processed in a control device *10*, and monitored by a speed meter incorporated in the control device *10*. In this case, a speed sensor that is configured to transmit the number of pulses in proportion to the speed or the moving distance is suitable as the speed sensor *9*.

[0025]

11 is a work sensor that detects the presence of the workpiece *2*. Said work sensor *11* detects the leading end of the moving workpiece *2*, transmits a signal (trigger signal), then stops transmitting the signal at the point when the workpiece *2* is no longer detected. Furthermore, the work sensor *11* is installed at a position upstream by distance "*a*" from the location of the center of the nozzle of the spray gun *3*, because of structural limitations at the installation site. That is, the distance "*a*" is the distance between the work sensor *11* and the spray gun *3*.

[0026]

21 is a sensor used to monitor the adhesive *16* being applied to the surface of the workpiece *2*. Said sensor *21* detects the leading end of the adhesive *16* applied on the surface of the workpiece *2*, transmits a signal, then stops transmitting the signal at the point when the adhesive *16* is no longer detected, i.e., the application of the adhesive is ended. Furthermore, the sensor *21* is installed at a position downstream by distance "*f*" from the location of the center of the nozzle of the spray gun *3*, because of structural limitations at the installation site. That is, the distance "*f*" is the distance from the spray gun *3* to the sensor *21*.

[0027]

The structure and action of the aforementioned spray gun *3* are as follows (with reference to Figure 1): If the electromagnetic valve *6* is turned on and air *8* is supplied from the air supply *7* to the spray gun *3*, the piston *12* of the spray gun *3* is pushed up against the force of a spring *13*, a needle *14* directly connected to the piston *12* is also pushed up, the needle valve mechanism is opened, and the adhesive 5 gushes out of the nozzle of the spray gun *3* onto the workpiece *2*, and is thus applied to the workpiece *2*. *16* indicates the adhesive applied to the workpiece *2*, i.e., a coating pattern. If the electromagnetic valve *6* is turned off and the air pressure which has kept the piston *12* up is released, the piston *12* is pushed down by the restoring force of the spring *13*, the needle valve mechanism is closed, and the spraying of the adhesive *5* ends. The restoring force of the spring *13* can be adjusted by the distance that screw *15* is screwed in or out.

[0028]

An air-driven spray gun is described in this example, however an air-driven spray gun is not the only choice, e.g., an electromagnetic direct-acting spray gun may also be used. It is also true, however, that electromagnetic direct-acting spray guns are disadvantageous from the standpoint of installation space, since a large electromagnetic coil is needed to provide a given driving force when handling a fluid of high viscosity and at high pressure such as an adhesive. In contrast to this, air-driven spray guns can be designed to be small and compact, which is advantageous when handling fluids of high viscosity and at high pressure.

[0029]

When applying an adhesive by a coating device constructed in this way, the speed *v* of the conveyer *1* is first set with reference to the preceding process and subsequent process, which are not illustrated. This speed *v* is input to the control device *10* artificially or as

a relevant indication signal from the preceding or following process device. The nonillustrated driving device for the conveyer *1* is then adjusted to operate at speed *v* based on the speed *v* indication signal from the control device *10*. The speed *v* of the conveyer *1* is monitored by the speed meter in the control device *10* as a signal from the speed sensor *9*.

[0030]

Next, the adhesive coating location of the workpiece *2* is determined. Specifically, a coating start position *A* that is a certain distance "*b*" away from the leading end of the workpiece *2*, and a distance "*c*" over which the adhesive is to be applied to the workpiece *2* are determined. These location values are then input by calculating the time it takes for the coating start position *A* to advance to a location directly under the spray gun *3* after the leading end of the workpiece has been detected (i.e., a trigger signal is transmitted) by the work sensor *11*, i.e., time *T1* during which the coating start position *A* advances to directly below the nozzle by the distance "*a*" from the work sensor *11* to the nozzle center position of the spray gun *3*, and time *T2* (corresponding to distance "*c*") during which the spray gun *3* is kept open and the adhesive is applied, i.e., the values *T1* and *T2* are input artificially into the control device *10*.

[0031]

Specifically, the time *T1* during which the coating start position *A* advances to the nozzle center position of the spray gun after the leading end of the workpiece is detected by the work sensor *11*, is the distance $a + b$ divided by the speed *v* being monitored by the speed sensor *9*, and calculated as $T1 = (a + b)/v$. The time *T2* during which the spray gun *3* is kept open, is the distance "*c*" over which the adhesive is applied divided by the speed *v* being monitored by the speed sensor *9*, i.e., it can be calculated as $T2 = c/v$.

[0032]

Furthermore, time *T1* and time *T2* may be calculated by the arithmetic function of the control device *10*, by feeding the distance data (magnitude), i.e., distances *a*, *b*, and *c*, directly into the control device *10*. These values, i.e., speed *v*, time *T1*, and time *T2* are set in the control device *10* as basic data, and stored in a memory device in the control device *10*.

[0033]

Next, the control device *10* calculates a coating pattern such that the intended ideal adhesive coating pattern is shifted to a location based on the sensor *21* which monitors the state of the coating procedure. In this case, the valve to be determined by calculation is the time *Ts* it takes the start point *A* of the adhesive to be applied to reach the location of the sensor *21* after the trigger signal.

[0034]

In concrete terms, time *Ts* during which the coating start position *A* advances to the location of the sensor *21* after the leading end of the workpiece is detected (i.e., a trigger signal is transmitted) by the work sensor *11*, is the distance $a + b + f$ divided by the speed *v* being monitored by the speed sensor *9*, and can be calculated as $Ts = (a + b + f)/v$.

[0035]

Here, *Ts* may be calculated by the arithmetic function of the control device *10* by feeding the distance data (magnitude) *a*, *b*, *c*, and *f* directly into the control device *10* in much the same way as the aforementioned time *T1* and time *T2*. This value, i.e., time *Ts*, is set in the control device *10* as basic data and thus stored in a memory device in the control device *10*.

[0036]

When coating work begins and the leading end of the workpiece *2* conveyed by the conveyer *1* is detected by the work sensor *11*, the controller *10* transmits an open signal to the electromagnetic valve *6* after the lapse of time *T1* after the leading end of the workpiece *2* has been detected, and opens the electromagnetic valve *6*. The air *8* for driving the spray gun *3* is then supplied to the spray gun *3*; the piston *12* is pushed up against the force of the spring *13*; the needle *14* directly connected to the piston *12* is also pushed up and the needle valve mechanism is opened; and the adhesive *5* flows out of the nozzle of the spray gun *3* with great force onto the workpiece *2*, and is thus applied to the workpiece *2*.

[0037]

When time *T2* elapses from the start of coating, the controller *10* stops the actuation of the electromagnetic valve *6* and turns off the electromagnetic valve *6*, so that the air pressure which has kept the piston *12* up, is released. The piston *12* is then pushed down by the restoring force of the spring *13*, and the needle valve mechanism is closed, so that coating of the adhesive ends.

[0038]

When the adhesive actually applied on the surface of the workpiece *2*, i.e., the coating pattern *16*, advances to the location of the sensor *21* used to mon-

itor the state of the coating procedure, the sensor *21* will detect the leading end of the adhesive *16* and transmits a signal. The controller *10* then measures time *ts* from the trigger signal, i.e., the detection of the workpiece *2* by the work sensor, to the detection of the leading end of the adhesive *16* by the sensor *21*. If the sensor *21* detects the terminal end of the adhesive *16* in a similar manner and the signal transmission of the sensor *21* is stopped, the coating time *t2* from the actual start of coating of the adhesive on the workpiece *2* to the completion of coating is measured.

[0039]

In the controller *10*, the measured time *ts* is compared with the previously set and stored time *Ts*, and the difference $\Delta t1$ between these two is calculated as an arithmetic operation. Similarly, the time *T2* and time *t2* are compared, and their difference $\Delta t2$ is calculated. That is, $Ts - ts = \Delta t1$ (which corresponds to *d* in the figure), and $T2 - t2 = \Delta t2$ are calculated. The values $\Delta t1$ and $\Delta t2$ are thus displacement information on the coating pattern.

[0040]

If the value of $\Delta t1$ or $\Delta t2$ deviates from the value determined in advance, the operation is judged as a coating error, and the signal thereof can be used as an information signal to turn on an alarm lamp, or to stop the line, or to remove the subject workpiece downstream from the production line as a product to be rejected.

[0041]

Furthermore, if the adhesive is not applied at all for some reason, such as system failure, no signal will be produced from the sensor 21; accordingly, the values $\Delta t1$ and $\Delta t2$ will not be calculated. The arithmetic function of the controller *10* can be set up so as to also judge a case of this kind as a coating error, and then output an error signal.

[0042]

These relationships are illustrated in Figure 3. In other words, Figure 3 shows the various coating work operations in the form of time charts, where "*I*" [*i, ro, ni, ho, etc. are essentially characters in the Japanese syllabary -- Tr. Ed.*] shows the operation of the work sensor *11*, where the signal rise point *x* works as the trigger signal. "Ro" shows the intended coating pattern, which is designed so that an open signal will be sent to the electromagnetic valve after the time lapse *T1* from the trigger signal *x*, and a close signal will be sent to the electromagnetic valve after time *T2*. "Ha" shows the actually sprayed and coated state from the spray gun, where *d* and *e* indicate deviations from the intended coating pattern values. "Ni" shows the state where the intended coating pattern is shifted to the location of the sensor *21*, where *Ts* indicates the time from the trigger signal *x* to the time the leading end of the ideal coating pattern reaches the location of the sensor *21*. "Ho" shows the operation of the sensor *21*, where *ts* indicates the time from the trigger signal *x* to the time the sensor detects the actual coating start position, and *t2* indicates the time from the actual coating start detected by the sensor *21* to the end of the coating process.

[0043]

And the aforementioned $\Delta t1$ and $\Delta t2$ are displacement information on the coating pattern, and at the same time $\Delta t1$ and $\Delta t2$ are also the correction times for the next coating cycle. $\Delta t1$ is fed back as the correction time for time *T1* during which the coating start position *A* advances to the nozzle center position of the spray gun after the leading end of the workpiece has been detected by the work sensor *11*, and time *T1* is automatically corrected. Also $\Delta t2$ is fed back as the correction time for time *T2* during which the spray gun *3* is kept open, and time *T2* is automatically corrected.

[0044]

In other words, if the value of $\Delta t1$ is minus, the value of *T1* is decreased by that fraction, and the open signal of the electromagnetic valve is forwarded by the value of $\Delta t1$; if the value of $\Delta t1$ is plus, the value of *T1* is increased by that fraction, and the open signal of the electromagnetic valve is delayed by the value of $\Delta t1$. Similarly, if the value of $\Delta t2$ is minus, the value of *T2* is decreased by that fraction, and the close signal of the electromagnetic valve is forwarded by the value of $\Delta t2$; and if the value of $\Delta t2$ is plus, the value of *T2* is increased by that fraction, and the close signal of the electromagnetic valve is delayed by the value of $\Delta t2$.

[0045]

In this way, one cycle of the work of applying the adhesive ends, and when the work sensor *11* detects the leading end of the next workpiece *3* [*sic; 2? -- Tr. Ed.*] (i.e., a trigger signal is generated), the aforesaid coating cycle is started again. And this time the coating work is carried out with the values corrected by the previous coating cycle, i.e., $T1 + (\Delta t1)$ and $T2 + (\Delta t2)$, then these $T1 + (\Delta t1)$ and $T2 + (\Delta t2)$ values are stored temporarily in the controller *10* until the next correction command signal is input. Then, when the next correction signal is input, these values are replaced by the latest values corrected by that signal.

[0046]

[Advantages of the Invention]

As described above, the present invention can detect the deviation value of the actual coating time from the set coating time value as coating pattern displacement detection information, by comparing the actual coating time obtained from the sensor used to monitor the state of the coating procedure, with the set coating time value of the spray gun that has been input in the controller for a system for spray coating moving workpieces with a coating material from a spray gun, and can also automatically correct the coating delay or coating pattern deviation in the spray coating method, because it is arranged so as to output open and shut signals to the spray gun from the controller by automatically shifting and correcting the set coating time values by the deviation values, thus coating work of high quality, which always conforms to the intended coating pattern values, can be carried out.

[Brief Description of the Figures]

[Figure 1]

An explanatory diagram which illustrates the principal components of the invention method needed for spray coating moving workpieces with a coating material from a spray gun.

[Figure 2]

An explanatory perspective diagram which illustrates the principal components of the invention method needed for spray coating moving workpieces with a coating material from a spray gun.

[Figure 3]

A diagram which illustrates various coating work operations in the form of time charts.

[Figure 4]

An explanatory diagram of a conventional method for spray coating moving workpieces with a coating material from a spray gun.

[Figure 5]

An explanatory perspective diagram of a conventional method for spray coating moving workpieces with a coating material from a spray gun.

[Description of the Symbols]

(1) conveyer device; *(2)* workpiece; *(3)* spray gun; *(6)* electromagnetic valve; *(9)* speed sensor; *(10)* controller; *(11)* work sensor; *(16)* coating material applied; *(21)* sensor; *(a)* distance from the work sensor to the spray gun; *(b)* intended distance from the leading end of the coating material to the coating start position; *(c)* intended distance from the coating start position to the coating end position; and *(l)* distance from the spray gun to the sensor.

Claims

1. In a method for spray coating moving workpieces with a coating material from a spray gun, a method for detecting the displacement of the coating pattern, characterized in that the deviation value of the actual coating time from the set coating time value is determined by comparing the set coating time values to open and close the spray gun, which have been set in advance in a device for controlling the coating device, with the actual coating time information obtained from a sensor for monitoring the state of the spray coating procedure.

2. In a method for spray coating moving workpieces with a coating material from a spray gun, a method for correcting the displacement of the coating pattern, characterized in that the deviation value of the actual coating time from the set coating time value is determined by comparing the set coating time values to open and close the spray gun, which have been set in advance in a device for controlling the coating device, with the actual coating time information obtained from a sensor for monitoring the state of the spray coating procedure; and in that said controlling device is configured so as to output a spray signal to the spray gun by altering the set coating time value by the determined deviation.

[Detailed Description or the Invention]

FIG. 1

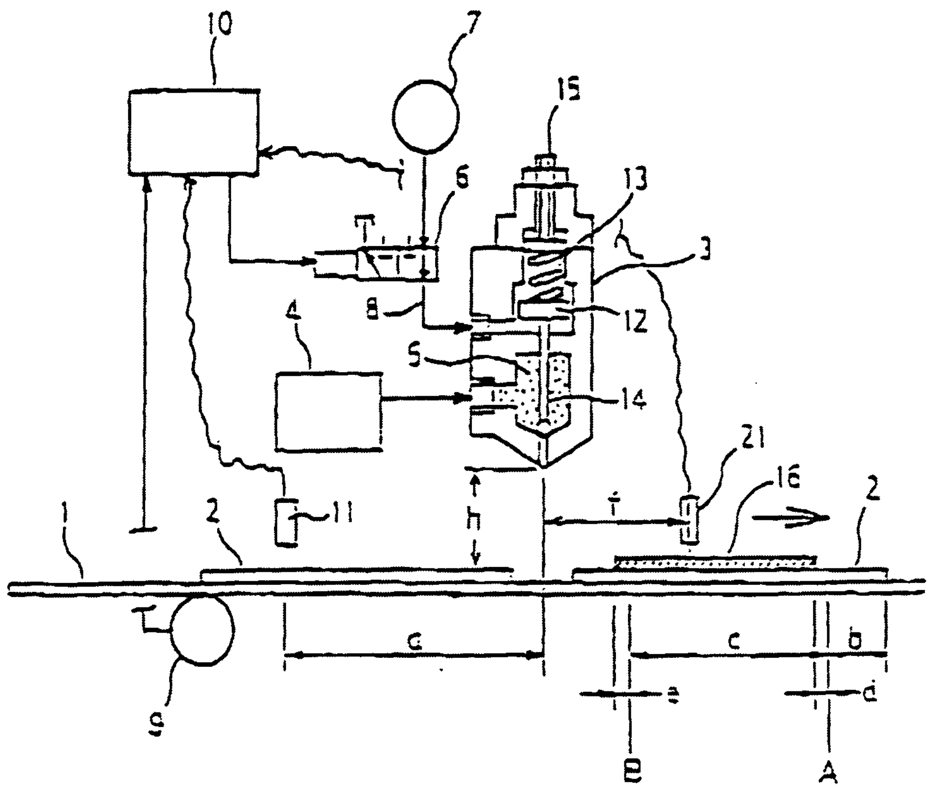
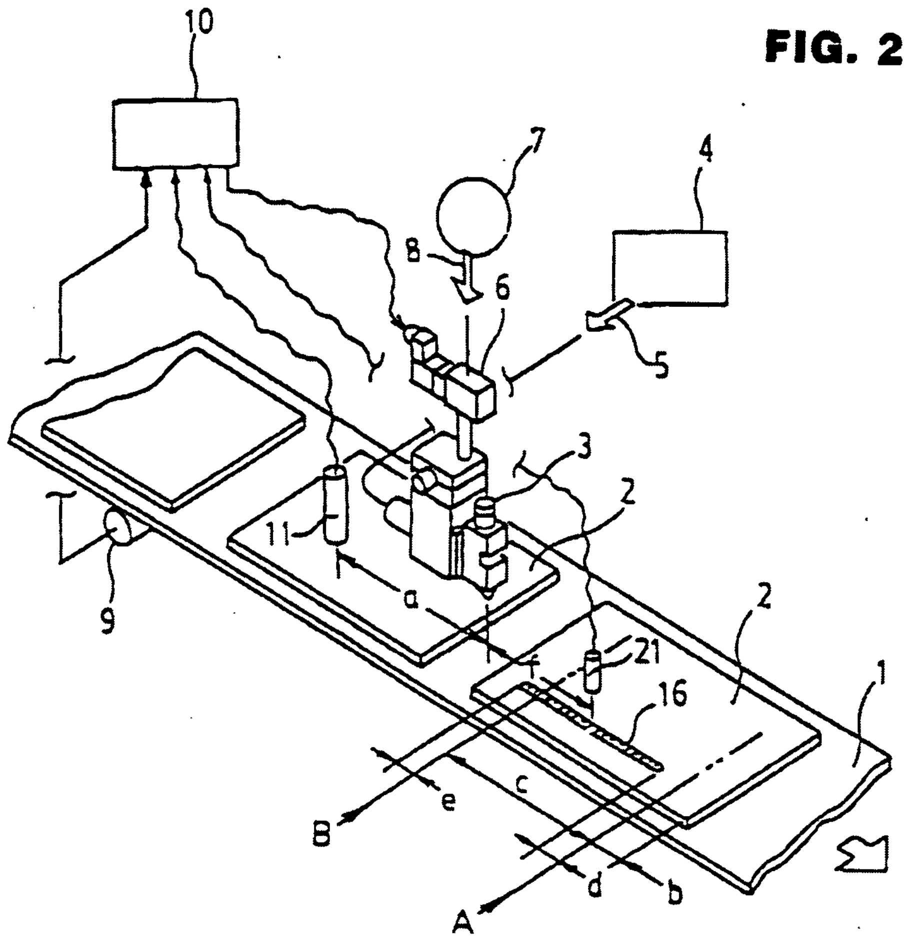


FIG. 2



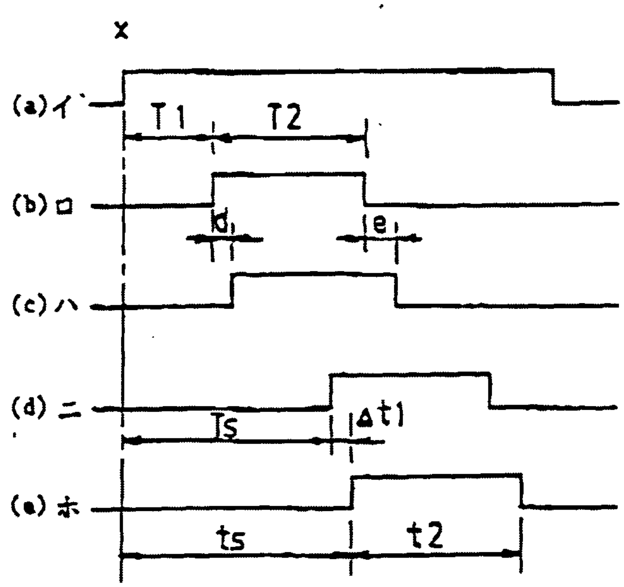


FIG. 3

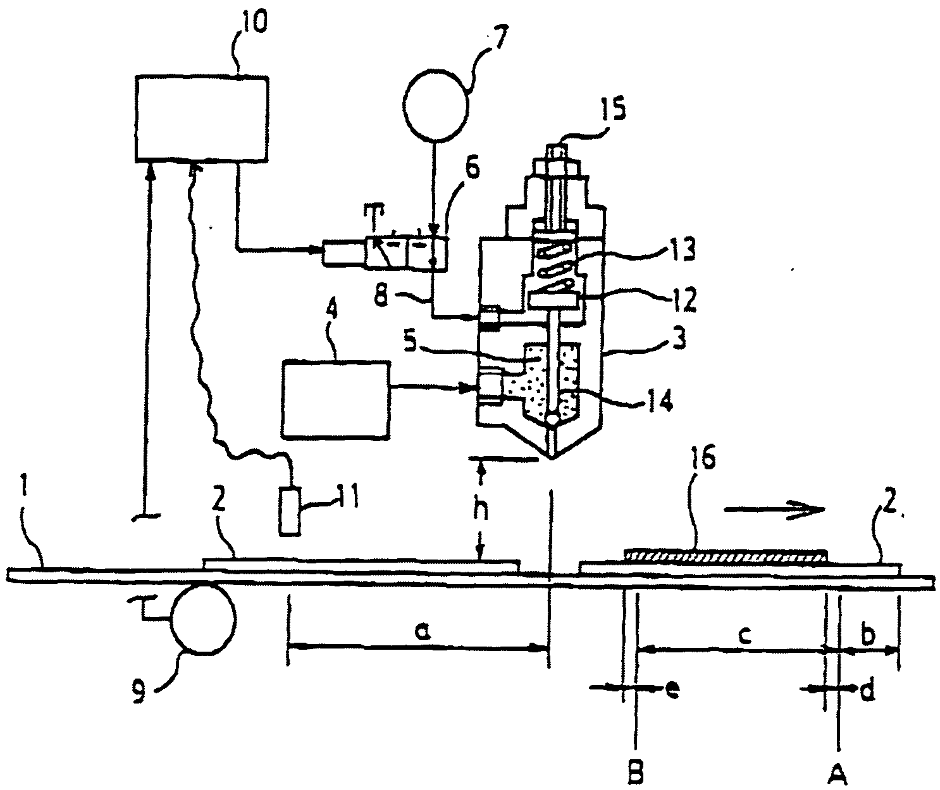


FIG. 4

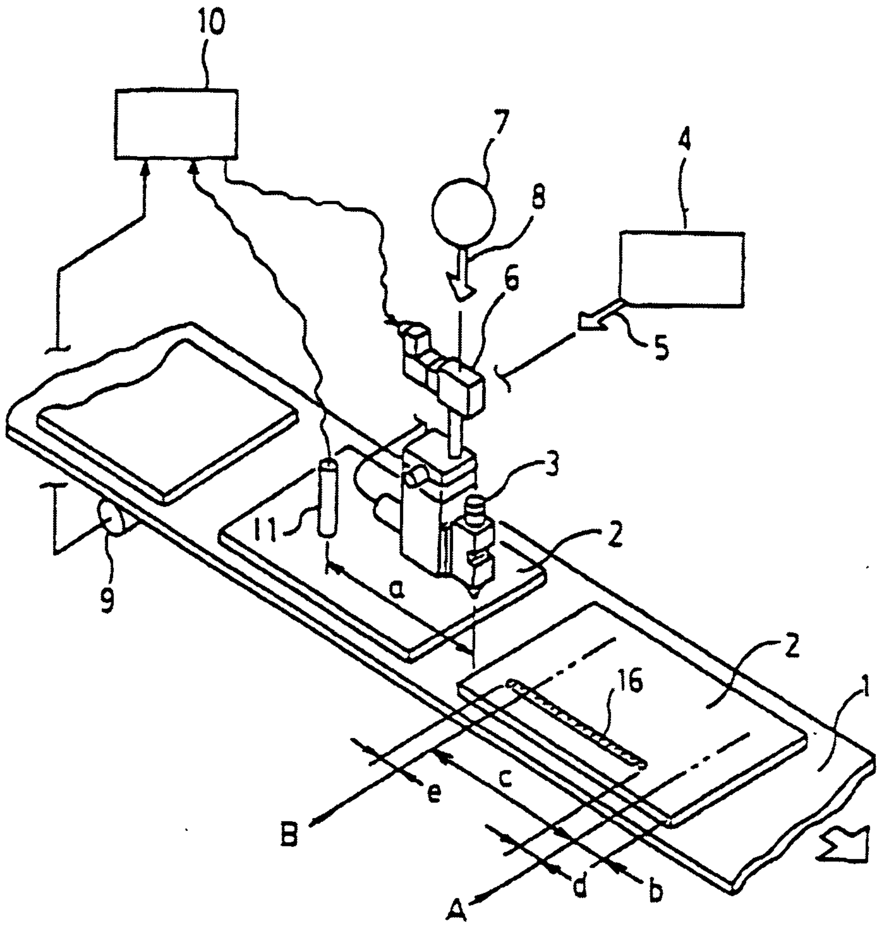


FIG. 5

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Application Number
EP 98 10 3231

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 288 878 A (BEHR INDUSTRIEANLAGEN; DAIMLER BENZ AG (DE)) 2 November 1988 * column 2, line 35 - column 5, line 21; figures 1,2 *	1,2	B05B12/12 B05B12/02
A	US 4 389 969 A (JOHNSON KEITH R) 28 June 1983 * column 2, line 21 - column 5, line 15; figures 1,2 *	1,2	
A	GB 2 289 941 A (NIRECO CORP) 6 December 1995 * page 8, line 8 - page 9, line 13; figure 1 *	1,2	
A	US 5 479 352 A (SMITH, WAYNE T.) 26 December 1995 * column 4, line 3 - column 6, line 29; figure 1 *	1,2	
A	US 4 164 001 A (PATNAUDE, EDMOND J.) 7 August 1979 * column 2, line 28 - column 3, line 21; figure 1 *	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B05B B05C
A	US 4 500 937 A (MATT, TIMOTHY S.) 19 February 1985 * column 2, line 49 - column 3, line 7; figure 1 *	1,2	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	6 July 1998	Innecken, A

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Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 3 682 131 A (ALGERI, HARVEY R. ET AL) 8 August 1972 * column 4, line 39 - column 7, line 67; figure 1 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

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